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Research Article

Association between eating disorders, macronutrient intake levels, and muscle mass percentage among university martial arts athletes

Emyr Reisha Isaura[1]*, Kinasih Josephine Gusti Wiyarso[2], Lindsay Ozora Sanyaezra Simanjuntak[3], Amanda Humaira Febriyanti[4], Sekar Arum Kinasih[5], Sri Sumartinigsih[6]
[1,2,3,4,5] Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Merr-C Campus Surabaya, 60115, Indonesia
[6] Department of Sports Science, Faculty of Sports Science, Universitas Negeri Semarang, Kampus UNNES Sekaran Semarang, 50229, Indonesia

*Corresponding author, email: emyr.reisha@fkm.unair.ac.id

ABSTRACT
Background: Combat sport athletes often engage in rapid weight-management practices that may increase the risk of disordered eating and inadequate nutritional intake, potentially affecting muscle mass and athletic performance. However, evidence regarding the relationship between eating disorder risk, macronutrient intake, and muscle mass among university martial arts athletes remains limited. Objective: This study examined the association between eating disorder risk and macronutrient intake with muscle mass among martial arts student club members at Universitas Airlangga. Methods: A cross-sectional study was conducted among 60 university students (≥18 years) selected through stratified random sampling from martial arts student activity clubs. Eating disorder risk was assessed using the Eating Attitudes Test-26 (EAT-26), dietary intake was measured using a semi-quantitative food frequency questionnaire, and body composition was evaluated using Bioelectrical Impedance Analysis (BIA). Training load was assessed using session Rating of Perceived Exertion (sRPE). Pearson correlation analysis was performed to determine associations between variables. Result: One-third of participants (33.3%) were classified as being at risk for eating disorders. Total EAT-26 score was not significantly associated with muscle mass ($r = -0.184$, $p = 0.160$). Isoleucine intake showed a significant positive correlation with muscle mass ($r = 0.271$, $p = 0.036$). In addition, adequacy percentages of leucine ($r = 0.339$, $p = 0.008$), isoleucine ($r = 0.367$, $p = 0.004$), and valine ($r = 0.342$, $p = 0.008$) were positively associated with muscle mass. No significant associations were found for total energy, carbohydrate, protein, or fat intake. Conclusion: Eating disorder risk was not associated with muscle mass, whereas BCAA adequacy, particularly isoleucine intake, was positively associated with muscle mass among university martial arts athletes.

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Branched-chain amino acids; eating disorders; macronutrient intake; martial arts athletes; muscle mass.

Introduction

Musculoskeletal injuries are highly prevalent across combat sports, with reported rates reaching 85.2% in Jiu-Jitsu, 86.6% in Karate, 65.2% Pencak Silat (Afis; 2026; Suryaningrum et al., 2025), and 85.3% in both Wrestling and Judo (Nery et al., 2022). Combat sports carry a substantial burden of injury, particularly in Taekwondo, where injury surveillance studies have reported that approximately 4.5–13.5% of athletes sustained at least one injury during international competitions, with the lower extremities and head being the most frequently affected areas (Jeong et al., 2025). Contact-related mechanisms, rapid weight-management practices, and repetitive high-intensity training have consistently been identified as major contributors to injury occurrence, highlighting the need for improved preventive strategies, athlete monitoring, and nutritional management in combat sport populations (Feng, 2025; Gunaydin et al., 2026; Jeong et al., 2025; Jeong et al., 2023). Recent evidence indicates that concussion-related emergency department visits among martial arts athletes increased following 2020, with males accounting for a greater proportion of injuries, particularly in Karate, Taekwondo, Jiu-Jitsu, and mixed martial arts (MMA). Falls and punch-related impacts were identified as the most common mechanisms of injury. At the same time, concussions frequently occurred during both competition and training activities, highlighting the substantial injury burden associated with combat sports participation (Kiehl et al., 2025). Rapid weight loss before competition has been associated with a greater likelihood of self-reported injury among combat sport athletes, particularly in males, with each 1% reduction in body mass within 24 hours before weigh-in increasing injury risk by approximately 20% (Doherty et al., 2025). Athletes who undergo rapid body weight reduction, particularly reductions exceeding 5% of body mass, may experience an increased risk of injury and adverse physiological consequences, including dehydration, muscle damage, and impaired recovery capacity.

Furthermore, rapid weight-loss practices in combat sports have been associated with unfavorable changes in body composition and physical condition, which may compromise athlete health and increase susceptibility to sports-related injuries (Baranauskas et al., 2022; Doherty et al., 2025; Hammer et al., 2023; Kim & Park, 2023). Rapid weight-reduction practices commonly used in combat sports have been associated with a greater prevalence of disordered eating behaviors, including restrictive eating, body dissatisfaction, and unhealthy food-control practices among athletes. Recent studies further indicate that athletes who engage in repeated weight-cutting strategies may exhibit moderate-to-high levels of eating disorder symptoms, suggesting that chronic weight-management pressure in weight-category sports could negatively affect both nutritional status and psychological well-being (Alwan et al., 2022; Flores et al., 2024; Ghazzawi et al., 2024). Disordered eating behaviors among athletes are commonly characterized by restrictive eating, meal skipping, compulsive exercise, and unhealthy weight-control practices driven by body image concerns and sport-specific performance pressures, particularly in weight-sensitive sports. Female athletes and athletes participating in aesthetic or combat sports appear to be more vulnerable to body dissatisfaction and maladaptive eating behaviors, with influences from coaches, peers, training environments, and psychological stress contributing to the development of eating disorder symptoms (Fernández-Aranda et al., 2023; Stewart et al., 2022; Vítková et al., 2025). However, previous research related to eating disorders was conducted on student athletes in sports, and the results showed a low risk of eating disorders (Plaschkes, Price, & Findon, 2025). Eating disorders are frequently associated with inadequate and imbalanced dietary intake, including deficiencies in macronutrient consumption such as insufficient protein, fat, and carbohydrate intake resulting from restrictive eating behaviors and reduced dietary diversity (Lelieveld et al., 2025). On the other hand, macronutrient intake plays an essential role in maintaining nutritional status (Feng, 2025).

Inadequate macronutrient intake among athletes may impair nutritional status, leading to lower body fat reserves, reduced muscle mass, and impaired physical performance, particularly in high-intensity and combat sports. Studies further indicate that appropriate energy and macronutrient consumption are essential for maintaining optimal body composition, supporting muscle mass development, and preserving athletic performance and recovery capacity (Baranauskas et al., 2023; Baranauskas et al., 2024). Muscle mass is an important determinant of muscle strength, which plays a protective role against sports-related injuries (Ionite et al., 2026; Li et al., 2025). Nevertheless, emerging evidence suggests that eating disorders may independently increase injury susceptibility among athletes, with body dissatisfaction, psychological stress, maladaptive eating behaviors, and external pressures from coaches or trainers contributing to their development. Additionally, college students are also susceptible to eating disorders due to academic stress, fatigue, and poor sleep quality associated with high academic workloads. However, student athletes in sports are known to have a lower risk of eating disorders. Therefore, this study aimed to examine the relationships among eating disorders, macronutrient intake, and muscle mass in student martial arts athletes.

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Method

Research Design

This cross-sectional study had a sample size of 90 and used the Yamane (1967) formula to obtain a sample of 60. Then, this study used stratified random sampling. Sampling was conducted by dividing the population into strata or groups, namely Kempo, Karate, Tapak Suci, Setia Hati Terate, Pagar Nusa, Jujitsu, Taekwondo, Merpati Putih, and Perisai Diri. The sample in this study included 60 university students aged ≥18 years or older who were active members of martial arts student activity clubs at Universitas Airlangga. Participants with current illnesses or injuries, or those following a specific diet (e.g., a weight-loss or fat-loss diet) during the data collection period, were excluded from the study. We included students from the eight martial arts student activity clubs recorded at the University, namely Taekwondo, Jiu-Jitsu, Karate, Kempo, and Pencak Silat (e.g., Merpati Putih, Pagar Nusa, Tapak Suci, Persaudaraan Setia Hati Terate).

Ethical Approval Statement

The study received approval from the ethics committee at the Faculty of Dental Medicine, Universitas Airlangga, with approval number 1100/HRECC.FODM/X/2025. All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Participant data were anonymized prior to analysis to ensure confidentiality and privacy.

Research Instruments

We assessed anthropometric data, such as body mass and body composition (e.g., fat mass, muscle mass, total body water), using a Bioelectrical Impedance Analysis (BIA) OneMed 825, while using a microtoise to measure participants' height. Anthropometric measurements were taken 1 to 2 hours before exercise. In the anthropometric measurements, the sample's height was measured with a micrometer, followed by body composition measurements using the BIA OneMed 825. BIA involved placing two distal current- or signal-introducing electrodes on the dorsal surfaces of the hand and foot, near the metacarpal-phalangeal and metatarsal-phalangeal joints, respectively (Walter-Kroker et al., 2011).

Nutritional status was classified based on Body Mass Index (BMI) according to the Asia-Pacific criteria adopted by the Indonesian Ministry of Health (Kementerian Kesehatan Republik Indonesia, 2025) underweight (<18.5 kg/m²), normal (18.5–22.9 kg/m²), and overweight/obese (≥23.0 kg/m²). Further, we assessed macronutrient intake (e.g., energy, carbohydrate, total protein, branched-chain amino acids (BCAAs), and fat) using a semi-quantitative food frequency questionnaire over the past 1 month, which was modified by Salsabila (2025), with Cronbach's alpha = 0.927. The BCAAs were leucine, isoleucine, and valine. The nutrient database in this study used the 2020 Indonesian Food Consumption Table and the US Department of Agriculture. On the other hand, we used a translated and validated version of the Eating Attitudes Test (EAT-26) questionnaire, which is widely used, with Cronbach's alpha = 0.909 (Gibrata et al., 2024), to assess self-reported symptoms and concerns characteristic of eating disorders. We assessed the athletes' training load using a formula developed by Carl Foster that multiplies the session duration of martial arts training (in minutes) by the session rating of perceived exertion (sRPE) on the Borg category-ratio 10 scale. The Borg Category-Ratio 10 scale was asked to athletes to rate their perceived exertion after training, from 0 meaning rest/no effort to 10 meaning maximal/exhaustive effort.

Data Analysis

All statistical analyses were performed using Stata version 17. We performed the descriptive analysis and presented the results using means and standard deviations, or numbers and percentages. Moreover, we used the Pearson correlation test to assess the relationship between the independent and dependent variables. Then, a multiple linear regression test was conducted to assess whether the variables independently influenced the dependent variable.

Results and Discussion

Results

The study included 60 martial arts athletes with a mean age of 20 years and an average martial arts practice duration of 5 years. Participants had a mean BMI of 22.8 kg/m², with nearly half classified as overweight/obese (48.3%), while 10% were underweight. The average weekly training characteristics showed a session duration of 120 minutes, a mean sRPE of 9.6, and a training load of 165.6 AU, indicating relatively high training intensity. Nutritional intake analysis demonstrated that carbohydrate and protein intake percentages exceeded 80% of requirements on average, whereas fat intake adequacy was lower at 65.6%. Based on EAT-26 scores, one-third of participants (33.3%) were categorized as being at risk for eating disorders or abnormal eating attitudes (Table 1).

Table 1. Participants' Characteristics (n=60)

Variable	Value
Age, year	20(2)
Duration of Martial Arts Practice, year	5(5)
Body Weight, kg	60.3(13.9)
Height, cm	161.8(8.3)
Body Mass Index, kg/m^2	22.8(3.9)
Session Duration, minute	120.5(38.1)
Mean of sRPE per week	9.6(3.6)
Training Load per week, AU	165.6(88.8)
Fat Mass	26.9(9.2)
Muscle Mass	68.0(8.6)
Total Body Water	53.6(6.8)
Energy Intake, kcal	1964.6(648.9)
Carbohydrate Intake, g	317.2(115.7)
Total Protein Intake, g	59.8(17.3)
Leucine Intake, mg	4.6(1.4)
Isoleucine Intake, mg	2.6(0.8)
Valine Intake, mg	2.8(0.9)
Fat Intake, g	47.7(22.7)
Percentage of Energy Intake	79.3(23.4)
Percentage of Carbohydrate Intake	80.8(26.4)
Percentage of Total Protein Intake	92.9(25.9)
Percentage of Leucine Intake	557.2(174.5)
Percentage of Isoleucine Intake	447.0(140.9)
Percentage of Valine Intake	476.0(151.4)
Percentage of Fat Intake	65.6(29.4)
Total EAT-26 score	17.4(12.7)
Gender, %	
Female	26(43.3)
Male	34(56.7)
Attending Education Level, %	
Diploma	24(40.0)
Bachelor	36(60.0)

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Table 1. *Continued*

Variable	Value
Martial Art Type, %	
Taekwondo	9(15.0)
Karate	14(23.3)
Kempo	7(11.7)
Jiu-Jitsu	4(6.7)
Pencak Silat – Merpati Putih	5(8.3)
Pencak Silat – Pagar Nusa	6(10.0)
Pencak Silat – Persaudaraan Setia Hati Terate	5(8.3)
Pencak Silat – Tapak Suci	10(16.7)
Eating Disorder Risk, %	
Low risk/normal eating attitudes (<20)	40(66.7)
Risk of eating disorder/abnormal eating attitudes (≥20)	20(33.3)
Nutritional Status, %	
Underweight	6(10.0)
Normal	25(41.7)
Overweight/Obese	29(48.3)

Note: sRPE, session rating of perceived exertion; AU, arbitrary units. Values were number(percentage) for categorical data and mean(standard deviation) for continuous data.

Table 2. Correlation between Independent Variables and Muscle Mass

Variable	Muscle Mass	
	r-score	p-value
Total EAT-26 score	-0.184	0.160
Body Mass Index, kg/m^2	-0.478	<0.001
Training Load per week, AU	0.104	0.427
Fat Mass	-1.000	<0.001
Total Body Water	1.000	<0.001
Energy Intake, kcal	0.189	0.147
Carbohydrate Intake, g	0.126	0.339
Total Protein Intake, g	0.223	0.086
Leucine Intake, mg	0.244	0.060
Isoleucine Intake, mg	0.271	0.036
Valine Intake, mg	0.244	0.061
Fat Intake, g	0.164	0.211
Percentage of Energy Intake	0.040	0.762
Percentage of Carbohydrate Intake	-0.013	0.919
Percentage of Total Protein Intake	0.116	0.379
Percentage of Leucine Intake	0.339	0.008
Percentage of Isoleucine Intake	0.367	0.004
Percentage of Valine Intake	0.342	0.008
Percentage of Fat Intake	0.070	0.597

Note: We used a Pearson Correlation test to assess the relationship between independent and the outcome

Table 3. Output Value of Determination Coefficient

Model	R	R Square [b]	Adjusted R Square	Std. Error of The Estimate	Durbin-Watson
1	1.000[a]	1.000	1.000	0.0833	2.153

Table 2 shows that Pearson correlation analysis demonstrated that body mass index (BMI) was significantly and negatively correlated with muscle mass ($r = -0.478$, $p < 0.001$), indicating that higher BMI was associated with lower muscle mass among participants. Fat mass also showed a perfect negative correlation with muscle mass ($r = -1.000$, $p < 0.001$), while total body water exhibited a perfect positive correlation with muscle mass ($r = 1.000$, $p < 0.001$). Among dietary variables, isoleucine intake was significantly positively correlated with muscle mass ($r = 0.271$, $p = 0.036$). Additionally, the percentage adequacy of branched-chain amino acids (BCAAs), including leucine ($r = 0.339$, $p = 0.008$), isoleucine ($r = 0.367$, $p = 0.004$), and valine ($r = 0.342$, $p = 0.008$), showed significant positive correlations with muscle mass. In contrast, total EAT-26 score, training load, total energy intake, carbohydrate intake, total protein intake, fat intake, and percentage adequacy of energy, carbohydrate, protein, and fat intake were not significantly associated with muscle mass.

Table 3 shows that the correlation coefficient is 1.000, indicating a very strong relationship between the independent and dependent variables in this study. In addition, the coefficient of determination is 1.000. This indicates that the independent variable accounts for 100% of the variation in the dependent variable in this study.

For the overall test, the null hypothesis (H0) is that the regression model is insignificant (not suitable for use). Using a significance level (α) of 10%, based on the output in Table 4, the significance value (p-value) is <0.001, so the p-value is smaller than α (0.1). This indicates that Ho is rejected, meaning that the regression model is suitable for use.

Table 4. Parameter Estimation Output for Overall Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4400.064	18	244.448	35198.528	<0.001[b]
Residual	0.285	41	0.007		
Total	4400.349	59			

Based on Table 5, variables that independently affect muscle mass include fat mass, which has a significant negative effect on the percentage of muscle mass ($B = -0.945$; $p < 0.001$). Furthermore, body mass index also has a significant positive effect on the percentage of muscle mass ($B = 0.035$; $p = 0.003$). The variable with the greatest influence on the percentage of muscle mass is body mass index.

Table 5. Parameter Estimation Output for Multiple Linear Regression Test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	92.646	0.192		482.427	<0.001	92.258	93.034
Training Load	-4.008E-5	<0.001	<0.001	-0.296	0.769	<0.001	<0.001
Fat Mass	-0.945	0.003	-1.005	-290.755	<0.001	-0.952	-0.939
Body Mass Index, kg/m^2	0.035	0.011	0.016	3.209	0.003	0.013	0.057

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Table 5. *Continued*

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
Total EAT-26 score	<0.001	0.011	-0.001	-0.336	0.739	-0.003	0.002
Energy Intake, kcal	2.885E-5	0.001	0.002	0.031	0.975	-0.002	0.002
Carbohydrate Intake, g	0.000	0.001	0.006	0.131	0.897	-0.006	0.007
Total Protein Intake, g	0.001	0.013	0.002	0.087	0.931	-0.024	0.027
Leucine Intake, mg	-0.62	0.490	-0.010	-0.127	0.899	-1.052	0.928
Isoleucine Intake, mg	0.532	0.984	0.051	0.541	0.591	-1.454	2.519
Valine Intake, mg	-0.438	1.187	-0.045	-0.369	0.714	-2.834	1.958
Fat Intake, g	-0.003	0.012	-0.008	-0.245	0.808	-0.207	0.021
Percentage of Energy Intake	-0.001	0.022	-0.004	-0.060	0.953	-0.046	0.043
Percentage of Carbohydrate Intake	-0.002	0.013	-0.006	-0.163	0.871	-0.028	0.024
Percentage of Total Protein Intake	-0.001	0.013	-0.004	-0.154	0.879	0.017	0.015
Percentage of Leucine Intake	0.001	0.004	0.020	0.257	0.798	-0.007	0.009
Percentage of Isoleucine Intake	-0.004	0.006	-0.061	-0.630	0.532	-0.016	0.008
Percentage of Valine Intake	0.003	0.007	0.053	0.443	0.660	-0.011	0.017
Percentage of Fat Intake	0.001	0.009	0.005	0.169	0.867	-0.016	0.019

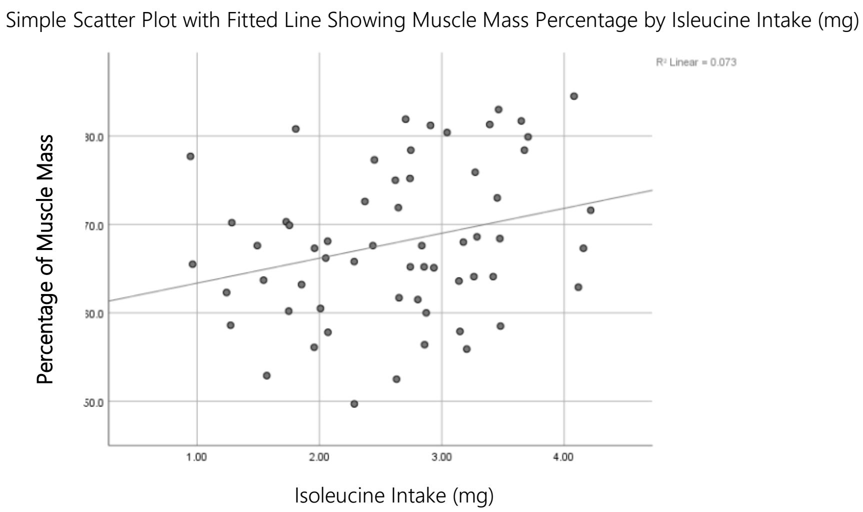

Figure 1. Association between isoleucine intake and muscle mass percentage among martial arts athletes

Figure 1 shows that isoleucine intake has a positive relationship with muscle mass, but the strength of the relationship is weak.

Discussion

The present study aimed to examine the relationships between eating disorder risk, macronutrient intake, and muscle mass among members of the martial arts student activity club at Universitas Airlangga. The findings demonstrated that the total EAT-26 score was not significantly associated with muscle mass ($r = -0.184$; $p = 0.160$). Eating disorders, particularly anorexia nervosa, have been associated with reductions in muscle mass among athletes due to chronic energy deficiency, restrictive eating behaviors, and impaired protein metabolism. Athletes participating in weight-sensitive and aesthetic sports, including martial arts, are considered particularly vulnerable because they often engage in rapid weight loss practices and dietary restriction to maintain competitive body weight categories (Rosa-Caldwell et al., 2023). Prolonged low energy availability can suppress muscle protein synthesis and increase protein catabolism, resulting in loss of lean body mass and impaired muscular recovery. In anorexia nervosa, severe caloric restriction leads to metabolic adaptations characterized by reduced anabolic hormone production, decreased glycogen storage, mitochondrial dysfunction, and impaired skeletal muscle remodeling, all of which contribute to muscle wasting and reduced physical performance (Angelidi et al., 2024; Rosa-Caldwell et al., 2023). Restrictive dietary and high levels of exercise are athletes' efforts to increase muscle mass due to body image (Tonsberg et al., 2026). Therefore, the eating disorder results in the present study were not related to muscle mass because eating disorder variables alone cannot affect muscle mass.

Furthermore, disordered eating behaviors in athletes may coexist with excessive exercise, thereby exacerbating energy deficits and accelerating muscle tissue breakdown. Previous studies have also reported that inadequate nutritional intake among athletes with eating disorders negatively affects training adaptation, muscular strength, and recovery capacity (Quesnel et al., 2023). The risk of eating disorders may also be influenced by the results of recent competitions (Rojas-Padilla, Portela-Pino, & Martínez-Patiño 2024). Nevertheless, the degree of muscle mass reduction may vary depending on training status, duration of illness, nutritional adequacy, and compensatory physiological mechanisms, which may explain inconsistent findings across studies regarding the association between eating disorders and muscle mass (Angelidi et al., 2024; Quesnel et al., 2023; Rosa-Caldwell et al., 2023).

Furthermore, the mechanism underlying muscle mass alterations during eating disorders remains incompletely understood, particularly among physically active populations such as athletes, which may explain the absence of a significant association in the present study. In addition, most participants were categorized as having low-risk or normal eating attitudes (66.7%), which may have reduced the variability needed to detect a significant relationship. Among nutritional variables, isoleucine intake showed a significant positive correlation with muscle mass ($r = 0.271$; $p = 0.036$). Similarly, the percentage adequacy of leucine, isoleucine, and valine intake also demonstrated significant positive correlations with muscle mass. These findings support prior evidence that branched-chain amino acids (BCAAs), particularly isoleucine, contribute to muscle hypertrophy by stimulating myogenesis and regulating intramyocellular lipid metabolism (Liu et al., 2021; Muscella et al., 2024). Isoleucine has been reported to promote glucose uptake and protein synthesis in skeletal muscle, thereby supporting muscle maintenance and growth. The positive association observed in this study suggests that adequate BCAA intake may play an important role in maintaining muscle mass among martial arts athletes undergoing high-intensity training (Baranauskas, Kupciunaite, & Stukas, 2023; Goldman et al., 2024). However, in the multiple linear regression analysis, isoleucine did not have an independent effect on muscle mass ($p = 0.591$). This is because isoleucine must be combined with exercise, especially resistance training, to increase muscle mass (Dudgeon, Kelley, & Scheett 2016).

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In contrast, total energy intake was not significantly associated with muscle mass ($r = 0.189$; $p = 0.147$). This finding is consistent with previous studies indicating that energy intake alone may not directly influence muscle mass because muscle hypertrophy is more dependent on adequate protein availability and exercise stimulus (Holtzman & Ackerman, 2019). Energy primarily serves as a substrate for ATP production through the oxidation of carbohydrates, proteins, and fats, which primarily supports muscle contraction and physical performance rather than directly increasing muscle mass. Therefore, although sufficient energy intake is important for athletic performance, it may not independently determine the percentage of muscle mass. Carbohydrate intake also showed no significant relationship with muscle mass ($r = 0.126$; $p = 0.339$). Carbohydrates primarily function to replenish glycogen stores and provide energy during exercise. However, increases in muscle mass generally require resistance-training-induced muscle tension combined with adequate nutrient intake, meaning that carbohydrate intake alone may not substantially stimulate muscle hypertrophy (Henselmans et al., 2022). This may explain the lack of association observed in the present study, despite relatively high carbohydrate adequacy among participants.

Similarly, total protein intake was not significantly correlated with muscle mass ($r = 0.223$; $p = 0.086$). Although protein is essential for muscle protein synthesis and muscle hypertrophy, its effectiveness is strongly influenced by exercise type, training intensity, and recovery adaptation (Zhao et al., 2024). The present study did not evaluate resistance training programs, exercise volume, or training specificity, which may explain why higher protein intake did not significantly translate into greater muscle mass. Nevertheless, previous studies have demonstrated that increased protein intake, combined with an appropriate exercise stimulus, enhances protein synthesis and promotes muscle hypertrophy (Camera, 2022). Fat intake was likewise not significantly associated with muscle mass ($r = 0.164$; $p = 0.211$). Dietary fat is more closely related to body fat accumulation and energy metabolism than to direct stimulation of muscle protein synthesis. During anaerobic exercise, metabolic adaptations involving fatty acid mobilization and triglyceride utilization may affect adipose tissue metabolism more substantially than skeletal muscle hypertrophy (Tomczyk et al., 2023). This mechanism may explain the absence of a significant relationship between fat intake and muscle mass in the present study.

Although leucine and valine intake were not significantly associated with muscle mass individually, the adequacy percentages of these amino acids demonstrated significant positive correlations (Shen et al., 2024; Zhao et al., 2024). Leucine is recognized as a major activator of the mTOR signaling pathway involved in muscle protein synthesis; however, its anabolic effects depend on several interacting factors, including insulin secretion, substrate availability, exercise stimulus, and metabolites such as β-hydroxy-β-methylbutyrate (HMB) (Camera, 2022; Castillo et al., 2022; Tomczyk et al., 2023). Since the present study assessed only dietary intake and did not evaluate these physiological factors, the direct association between leucine intake and muscle mass may not have been fully captured. Meanwhile, valine metabolism may be influenced by body composition, particularly elevated adiposity, which can impair mitochondrial function and reduce the efficiency of muscle protein synthesis (Chae et al., 2021; Rathmacher et al., 2025). This explanation is relevant because nearly half of the participants in the present study were classified as overweight or obese (48.3%), with a mean BMI of 22.8 ± 3.9 kg/m².

Limitations of Study

The limitation of this study is its relatively small sample size; it is hoped that future research will include a larger sample. Furthermore, the SQFFQ questionnaire is subject to bias due to its reliance on the sample's memory. This study also did not measure energy availability, anabolic hormones, and other factors that could influence the research results.

Conclusions

This study demonstrated that eating disorder risk was not significantly associated with muscle mass among martial arts student athletes at Universitas Airlangga, despite approximately one-third of participants being categorized as at risk for eating disorders. Among nutritional variables, isoleucine intake and the adequacy of branched-chain amino acids (BCAAs), including leucine, isoleucine, and valine, were positively associated with muscle mass, whereas total energy, carbohydrate, protein, and fat intake showed no significant relationships. These findings suggest that specific amino acid profiles may be more associated with muscle mass maintenance than total macronutrient intake alone in martial arts athletes. The absence of significant associations between eating disorder risk and muscle mass may be attributable to the predominance of low-risk eating attitudes, training adaptations, and the multifactorial nature of muscle regulation in physically active populations. Future longitudinal studies incorporating training characteristics, energy availability, exercise modality, and physiological biomarkers are warranted to elucidate better the complex interactions among eating behaviors, nutritional intake, and body composition in combat sport athletes.

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Authors' contributions

K.J.G.W. conceived and designed the study, collected and assembled the data, performed the data analysis and interpretation, drafted the manuscript, and approved the final version of the article. E.R.I. contributed to the study conception and design, critically revised the manuscript, and approved the final version. L.O.S.S., A.H.F., and S.A.K. contributed to data analysis and interpretation, participated in manuscript preparation, and approved the final version of the article. S.S. critically revised the manuscript and approved the final version. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

AI Disclosure Statement

During the preparation of this manuscript, the authors used Grammarly to proofread the English text. All AI-generated outputs were critically reviewed and thoroughly edited by the authors to ensure factual accuracy, clarity of expression, and compliance with academic standards. The authors take full responsibility for the integrity and content of this manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author, ERI. The data are not publicly available because they contain information that could compromise the privacy of research participants.

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